as it spins in hard disc drives.

There is a need for design features and manufacturing techniques that serve to reduce the variance in system wide resonance and obtain a more predictable and uniform system-wide resonance for a hard disc drive and hard disc drive components. Therefore, the present invention provides a method to obtain predictable and uniform system wide resonance as much as possible and to tune the frequency of resonance to enable reductions in sympathetic system wide resonances, thereby leading to lower vibration and noise. The present invention also provides a method of enclosing components of the hard disc drive to obtain a predictable and uniform system wide resonance and to reduce both mechanical and magnetic vibration and noise.

Methods to enclose components of the hard disc drive with a synthetic resin have been suggested, but have not been used to obtain more uniform and predictable system-wide resonance. Prior art methods to mold a synthetic material enclosing hard disc drive components fail to produce a predictable system wide resonance due to several factors. First, the plastic material that is used to enclose the components has variations from lot to lot. In particular, the plastic may vary in viscosity by 60 percent from lot to lot. The molecular weight of the polymer molecules also begins to vary as heat is applied, causing the polymer molecules to become smaller, which causes variations in the viscosity of the molten polymer and stiffness of the solidified polymer. Second, the polymers exhibit non-newtonian rheology and the density of the polymer inside a mold cavity is not uniform. Third, in the past, it has not been possible to control process variables to

obtain a relatively uniform volume of polymer, orientation of the polymer as it enters the mold cavity, nor ensure a uniform rate of crystallization as the polymer solidifies.

One example of an overmolded stator and a method of manufacturing such a stator is shown in U.S. Patent No. 6,075,304 (Nakatsuka) (incorporated herein by reference). Referring to FIGS. 6 and 7 of this patent, a stator 11 is encapsulated with an overmold 12. The patent discloses that the injection speed of the polymer should be more than twice the injection speed of a standard injection molding process. The patent also discloses a molding tool capable of pressure dampening to reduce rapid pressure increase. However, this patent does not teach how to obtain predictable and uniform resonance for a hard disc drive or a hard disc drive components.

An example of a spindle motor is shown in U.S. Patent No. 5,694,268 (Dunfield et al.) (incorporated herein by reference). Referring to FIGS. 7 and 8 of this patent, a stator 200 of the spindle motor is encapsulated with an overmold 209. The overmolded stator contains openings through which mounting pins 242 may be inserted for attaching the stator 200 to a base. U.S. Patent No. 5,672,972 (Viskochil) (incorporated herein by reference) also discloses a spindle motor having an overmolded stator. One drawback with the overmold used in these patents is that it has a different coefficient of linear thermal expansion ("CLTE") than the corresponding metal parts to which it is attached. This patent also does not teach a method or structure for obtaining predictable and uniform resonance.

U.S. Patent No. 5,806,169 (Trago) (incorporated herein by reference) discloses a method of fabricating an injection molded motor assembly. However, the motor disclosed in Trago is a step motor, not a high-speed spindle motor, and would not be used in applications such as hard disc drives. The patent does not disclose how to obtain uniform resonance. Thus, a need exists for an improved hard disc drive, hard disc drive components and methods for making the same that overcome the aforementioned problems.

BRIEF SUMMARY OF THE INVENTION

A hard disc drive has been invented which overcomes many of the foregoing problems. In addition, unique spindle motor assemblies, actuator assemblies and other components of a hard disc drive have been invented, as well as methods for manufacturing components for hard disc drives and other electrical components. In one aspect, the invention is a method for injection molding a layer of phase change material around a surface of each of a plurality of identical hard disc drive components which includes the steps of: providing a plurality of identical hard disc drive components; placing one of said plurality of identical hard disc drive components in a mold cavity of an injection molding machine having a controllable fill rate and a controllable injection pressure; closing said mold cavity; injecting a molten phase change material into said mold cavity at fill rates and injection pressures; monitoring pressure in the mold cavity; controlling the fill rate and/or injection pressure of said molten phase change material to obtain said hard disc drive component with the phase change material thereon; and repeating the above steps to produce said plurality of components each having a